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Discovering the Therapeutic Potential of *Thuja occidentalis*: A Comprehensive Review

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Abstract

Thuja occidentalis L. is a species of the Cupressaceae family that has been widely researched as regards its aerial part, most commonly leaves and twigs. Nevertheless, one of the least explored roots is the root system even though it has been used in traditional medicine in many indigenous and folk practices. This review summarizes the existing information on the phytochemical composition of the root, pharmacognostic, ethnobotanical, extract, and pharmacological properties. Particular emphasis is put on the comparison of root and aerial parts chemistry and bioactivities. The root has a different chemical profile with reduced thujone and increased phenolics and sesquiterpenes. Adventitious root morphology and resin duct anatomy are pharmacognostic features that are described. Aerial part uses are opposed to conventional uses of digestive and genitourinary disorders. Improved extraction methods to include Soxhlet, ultrasound-assisted and green solvent methods have been shown to yield better bioactivities. Antimicrobial, anti-oxidant, and anti-inflammatory potential are examples of biological activities that help to support ethnomedicinal claims. In spite of the insights, there is still a gap in the research between standardization, mechanistic research and clinical validations, which underscores the root as an untapped therapeutic resource that is subject to further research.

Keywords

Thuja occidentalis, phytochemistry, pharmacognosy, traditional medicine, extraction methods, bioactive compounds, comparative analysis.

1. Introduction:

Thuja occidentalis is an evergreen coniferous tree, which is native to eastern North America. It is a widely used ornamental plant which has unique scale-like leaves and conical form. *Thuja occidentalis* is a perennial evergreen conifer that originates from eastern regions of north america. It is commonly cultivated as an ornamental species due to its distinctive scale shaped foilage and characteristics conical growth pattern. In the sixteenth century, Native Americans in a trip had found the plant and applied in the treatment of scurvy induced weakness (Linzinger and Kroh 59). These are some of its major facts: the botany of erthe, ingredients, and some pharmacological action of this herbal remedy to common cold are all discussed in several reviews and monographs; most of them are however out obsolete and a few are in German.[1] In such a way, we attempted to develop an up-to-date, comprehensive, and evidence-based research of *Thuja occidentalis* concerning its phytochemistry, in vitro and in vivo

pharmacology, safety, and efficacy. To gain additional information or undistributed data, preparations manufacturers of Thuja preparation were identified and databases of MEDLINE researched.[2]

Figure 1. *Thuja occidentalis* plant

1.1 Taxonomy Classification

Table 1: Taxonomical classification of *Thuja occidentalis*

Sr. no.	Classification
Kingdom	Plantae
Subkingdom	Tracheobionta
Division	Coniferophyta
Class	Pinopsida
Order	Pinales
Family	Cupressaceae
Genus	Thuja
Species	Occidentalis

1.2 HISTORY

The text provides a detailed description of ecological and management problems associated with the northern white-cedar (*Thuja occidentalis*) a common conifer in the northeastern United States and southeast Canada, thus leading to uninformed decisions about its management. The fourth most frequent conifer in Maine is balsam fir, eastern white pine and red spruce. Among the key issues raised are the decline in size of forest land and the volume of growing stock in the northern white-cedar forestland in Maine which is 7 percent and 8 percent respectively between 1982 and 2003. However, there was an increase in the quantity of saw timber growing stock during this period. The plant is facing challenges such as the poor early growth in large measure because of its high deer palatable value. rates and competition in mixed stands. Recruitment has not been easy as well. A research on the Big Reed Forest Preserve indicates that there has been minimal recruitment of sapling and pole woods.[3]

Thuja occidentalis common name:
Arborvitae (Latin tree of life).
Northern White Cedar
Swamp Cedar
American Arborvitae

Habitat Native Range: Eastern North America particularly southern Canada (Ontario, Quebec) and northeast of the United States (New England, Great Lakes region). Typical Habitats: Bogs and swamps: These habitats are usually found in peatlands and are preferred by moist and organic soils. Places that have a high level of limestone: Grows well in alkaline soils especially over calcium rocky outcrops. Cool, humid forests are found in coniferous or mixed woods some shades of which are present. Rocky outcrops and cliffs: Capable of clinging on fissures of the rocks with minimal soil.

Environmental Conditions

Soil Type: Moist, well-drained to poorly-drained soils; also tolerates a broad range of pH but likes alkaline. conditions. Sunlight: Needs full sun to half shade. Water Requirements: Hydrogamous; can withstand seasonal flooding and damp root systems. Climate: Cold-hardy; can survive in the USDA zones 2-7 and so suitable to cold temperate climates[5].

Thuja Occidentalis has special characteristics, some of which are listed below:

1. Physical characteristics Height: 20-60 Feet Spread: 10-15 Feet Color: Reddish-Brown Shape: conical Cones round (4-8mm long) in males, ovoid, purplish in females.

2. Chemical characteristics Synet molecule (thujone, bornyl acetate, terpinyl acetate) Flavonoids Phenolic acids

3. Pharmacological characteristics Antimicrobial (bacterial, fungal, viral) Antioxidant Anti-inflammatory Anticancer Antidiabetic

4. Identification characteristics Twigs: Yellow-Green, Slender flat, in fern like sprays. Winter Boughs: small, naked, minute. Pollen cones: yellowish, scale black, on the ends of new shoots are visible in may may. Seed cones: Are small, oblong, reddish, 8-12 scales and the cones are present in April- May, ripen early in the autumn. Wood: Light, Soft, brittle, straight-grained, durable, fragrant, pale yellow-bro.

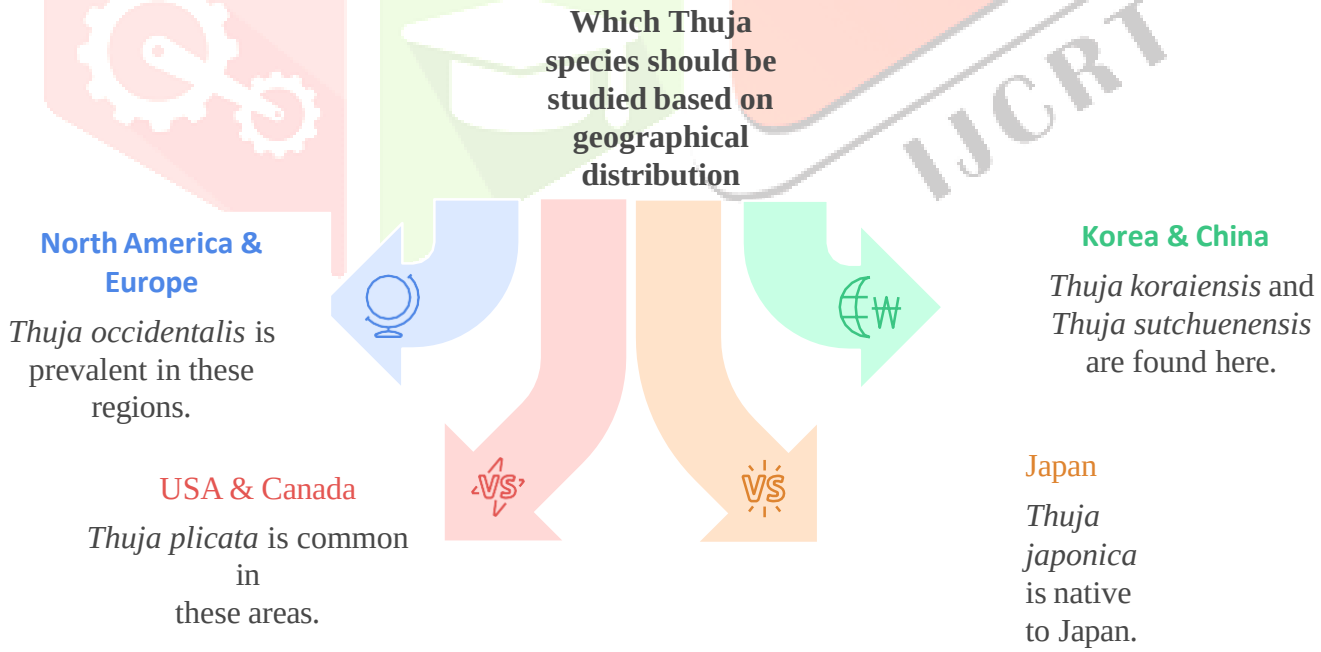

Figure 2. *Geographical distribution*

1.3 General description, botany and cultivation:

Thuja occidentalis is a species of cupressaceae family that has been widely researched as regards its aerial part,most commonly leaves and twings. However, the root system is remians relavtively underexplored, despite its traditional use in indigeneous and folk medicine practices this review presents comprehensive overview of the phytochemical profile and therapeutic potential of the root[6].

Thuja occidentalis is a perennial evergreen conifer that originate from the eastern regions of North America. It is commonly cultivated as an ornamental species due to its distinctive scale shaped foliage and characteristic conical growth pattern. Native to eastern North America, *Thuja occidentalis* is commonly referred to as arbor vitae or northern white cedar.

The natural distribution of *Thuja occidentalis* includes southern regions of canada and the northeastern united states. It is commonly found growing in moist environments such as wetlands, marshes and swampy areas.

The plant contains various bioactive constituents, including thujone, bornyl acetate, terpinyl acetate, flavonoids and phenolic compounds[7].
Pharmacological studies have demonstrated anti-microbial and antioxidant properties associated with its bioactive constituents

The tree has a pyramidal crown and exhibit monopodial branching with an upright trunk covered by reddish brown bark. Its branches are highly divided, short, flattened, and horizontally arranged, with terminal portions directed slightly upward. The foliage consists of small, scale like leaves that overlap closely, forming a dense covering over the branches. These leaves are evergreen, green in color, and oval in shape, with scales arranged in a cross pattern and tapering toward a convex dorsal surface

On the upper portions of the branches, glandular structures are present within the leaves, which contain resinous essential oils responsible for the plants characteristic strong aromatic camphor like odor and sharp balsamic taste. The plant produces small, oval shaped cones measuring about 6--8 mm in length. These cones appear greenish yellow initially and are located at the ends of branches. Each cone is composed of several scales and contains one to three ovules[8].

Young branches are commonly harvested for medicinal and industrial purposes, especially during the spring season in the northern hemisphere, when the concentration of active compounds is at its highest. After harvesting, the plant material should be properly dries and handled carefully to preserve its quality. This species demonstrates considerable adaptability to various environmental conditions, including both dry and water saturated habitats. It has the ability to tolerate water scarcity through osmotic adjustment mechanism, a physiological adaptation observed in both herbaceous and woody plant species. Regarding cultivation practices, observations from nursery operations and small scale producers in regions such as Rio Grande do Sul, Brazil indicate the propogation is commonly performed using healthy branches obtained from mature plants. These are cultivated in open fields for a period of two to four years before being transferred to containers for commercial sale. Field cultivation is generally preferred over direct pot cultivation, as it requires less technical expertise. The average cost of producing a single sapling has been estimated to be approximately R$ 2.79

2. Morphology plant in *Thuja occidentalis:*

Figure 3. Thuja leaves

2.1 Leaves:

- Colour: The colour is at first light green to yellow-green, and then turns brown after 3-4 years.
- Shape: Opposite-decussate, pairs of scale, and steady.
- Texture:
- Leathery and greasy; there are also glands of small resin on the underside.
- On crushing, there is the characteristic odor of the leaves.

Figure 4. Thuja Flower

2.2 Flowers:

- Modified to decrease water loss; the tiny recurrent scale leaves have reduced surface area and waxy cuticle of protection.
- Function: Ornamental value: Not significant
- Type of Reproduction: Monoecious (both female and male sexual organs are found)

Figure 5. Thuja Fruit

2.3 Fruits:

- When Baby: Sticky and blue-green, glaucous in look.
- When Mature: Woody, cone-like, horn-like, and medium brown.

Figure 6. Thuja bark

2.4 Bark:

- Color: Negro-brown, then grayish-brown.
- Touch: Fibrous and fissured, and excluding in stripes long and thin.
- Thickness: The mature trees have approximately 6-9 mm.
- Feature: None have resin blisters on the surface of the bark.
- Function: The role of the tree is to help in the protection of the tree and help retain water and control temperatures.

Figure 7. Thuja root

2.5 Thuja root:

- Type: Fibrous and shallow root system.
- Spread: Spreads horizontally with the help of which the plant stabilizes in the rocky or swampy soils.
- Adaptation: Very acclimated to calcareous and moist environments and cannot withstand long droughts.
- Heat: Gives the firm anchorage and effective collection of the nutrients through superficial layers of soil.

2.6 Comparison of various Thuja genus species

Table 2. Comparison of the bioactive potential of *T. occidentalis* with other *Thuja* genus species[9]

Thuja species	Benefits according to biological activities	
	Medicinal application	**Industrial application**
Thuja koraiensis	Demonstrates antimicrobial properties and free radical scavenging activity	No significant industrial application reported
Thuja occidentalis	Exhibit a wide range of pharmacological effects, including antimicrobial, antioxidant, anti inflammatory, anticancer, hepatoprotective, gastroprotective, antidiabetic, radioprotective, and fever reducing activities	Used as an antifungal agent for preservative of archival materials and also shows insecticidal potential
Thuja plicata	Known for antimicrobial, anti inflammatory, immune-regulating and tissue repair promoting activities	Applied as an antimicrobial agent in building and environmental decontamination
Thuja standishi	Shows antimicrobial effects and potential anticancer activity	No major industrial uses documented
Thuja sutchuenesis	Reported to possess antimicrobial activity	Industrial applications not clearly established

3. Review of Literature on Different Parts of Thuja occidentalis

3.1 Thuja occidentalis Bark

- Diterpenoids from Thuja standishii bark: -

In this study, a novel skeletal diterpene, standishinal, was isolated from the bark of Thuja standishii and its absolute stereo-structure was confirmed by X-ray crystallographic analyses.[10] The aromatase inhibitory potential of standishinal, along with eight previously identified diterpenes and four synthetically developed analogues,was assessed using a recombinant human aromatase enzyme system. The findings revealed that standishinal and its its diacetate derivative exhibited notable inhibitory effects against the aromatase enzyme.

- Labdane diterpenoids from Thuja standishii bark as cancer chemo preventive agents: -

In this study, seven labdane-type diterpenoids from the bark of Thuja standishii were found to have strong inhibitory effects on Epstein-Barr virus early antigen (EBV-EA) activation induced by 12-O-tetradecanoylphorbol-13-acetate (TPA). Among them, 15,16-bisnor-13-oxolabda-8(17), 11E-dien-19-oic acid was particularly potent, showing stronger inhibitory effects than beta-carotene, a well-known cancer chemo preventive agent. Additionally, 15,16-bisnor-13-oxolabda-8(17), 11E-dien-19-oic acid exhibited excellent anti-tumour promoting activity in a two-stage mouse skin carcinogenesis test using 7,12-dimethylbenz[a]anthracene and TPA[11].

- Cancer chemo preventive agents from Thuja standishii stem bark: -

Seven labdane-type diterpenoids and their analogues from the stem bark of Thuja standishii showed strong inhibitory effects on Epstein-Barr virus early antigen (EBV-EA) activation induced by 12-O-tetradecanoylphorbol-13-acetate (TPA). Among these compounds, 15,16-bisnor-13-oxolabda-8(17), 11E-dien-19-oic acid was particularly potent, exhibiting stronger inhibitory effects than beta-carotene, a well-known cancer chemo preventive agent. Additionally, 15,16-bisnor-13-oxolabda-8(17), 11E-dien-19-oic acid showed excellent anti-tumour promoting activity in a two-stage mouse skin carcinogenesis test using 7,12-dimethylbenz[a]anthracene and TPA[12]

- Potential antitumor promoting diterpenoids from Thuja standishii stem bark: -

In this study, six diterpenes, including one new compound, were isolated from the stem bark of Thuja standishii. The new compound, 15-oxolabda-8(17),13 Z-dien-19-oic acid, along with known compounds ferruginol, sugiol, isocupressic acid, sandaracopimaric acid, and 15-oxolabda-8(17),13 E-dien-19-oic acid, were tested for their inhibitory effects on Epstein-Barr virus early antigen (EBV-EA) activation induced by 12-O-tetradecanoylphorbol 13-acetate (TPA).[13] Compounds 2, 3, 4, and 5 showed strong inhibitory effects on EBV-EA induction.

3.2 Thuja leaves: -

- Anti-bacterial activity of thuja leaves: -

This study optimized the extraction process of essential oil from Thuja koraiensis Nakai branches and leaves. The best results were obtained with a material-to-liquid ratio of 50g/400ml, NaCl concentration of 6.0%, distillation time of 5 hours, and storing the branches in a dry condition. The essential oil showed antibacterial activity against Staphylococcus aureus, Bacillus subtilis, and Escherichia coli, with promising potential for insect repellents and essential oil soaps.[14]

- Anti-allergic activity of thuja leaves: -

This study looked at the effectiveness of topical treatments using extracts from Saussurea costus root (SC) and Thuja orientalis L. (TOL) in relieving symptoms of atopic dermatitis (AD), a chronic skin condition. The researchers applied these extracts to the skin of mice with AD-like symptoms and to human skin cells (HaCaT cells) exposed to allergens. They found that the combination of SC and TOL extracts reduced inflammation and immune responses better than either extract alone. Specifically, the combination decreased the expression of certain proteins and genes associated with inflammation, reduced mast cell infiltration, and lowered levels of certain antibodies linked to allergic reactions.

Overall, the study suggests that combining SC and TOL extracts may be an effective treatment option for managing AD. This could provide a natural alternative to traditional medications for this condition.

3.3 Thuja stem and root: -

- Anti-allergic action of thuja orientalis root: -

This study looked at the effectiveness of topical treatments using extracts from Saussurea costus root (SC) and Thuja orientalis L. (TOL) in relieving symptoms of atopic dermatitis (AD), a chronic skin condition. The researchers applied these extracts to the skin of mice with AD-like symptoms and to human skin cells (HaCaT cells) exposed to allergens. They found that the combination of SC and TOL extracts reduced inflammation and immune responses better than either extract alone. Specifically, the combination decreased the expression of certain proteins and genes associated with inflammation, reduced mast cell infiltration, and lowered levels of certain antibodies linked to allergic reactions.[15] Overall, the study suggests that combining SC and TOL extracts may be an effective treatment option for managing AD. This could provide a natural alternative to traditional medications for this condition.

- Antibacterial sesquiterpenes from Thuja sutchuenensis roots and stems: -

Eight new sesquiterpenes were isolated from the roots and stems of Thuja sutchuenensis, along with three known compounds. The structures were elucidated using NMR, mass spectroscopy, X-ray diffraction, and ECD measurements. The compounds showed potent antibacterial activity against various strains of Staphylococcus aureus and Bacillus cereus, with minimum inhibitory concentration (MIC) values observed between 6.25 and 25ug/ml.

- Chemical constituents of Thuja sutchuenensis trunks and roots: -

In this study, five new compounds were isolated from the 95% ethanolic extract of the trunks and roots of Thuja sutchuenensis,The isolated compounds included two stilbene derivatives, identified as thujasutchins A and B, along with two phenolic constituents, thujasutchins C and D, and a sesquiterpene designated as thujasutuchins E. the structural characterization of these compounds was accomplished using various spectrometric methods, including UV, IR,high resolution electrospray ionization mass spectrometry, and NMR analysis. furthermore, selected compounds was investigated for their in vitro cytotoxic potential against several human cancer cell lines, namely SF-268,MCF-77,HepG-2 and A549.[16]

- Study Of Antibacterial Activity & Phytochemical Test Of Thuja Occidentalis Root L. (Cupressaceae)

Thuja occidentalis, commonly known as Morpankhi, is a coniferous tree belonging to the Cupressaceae family. In this study, the root material was first dried, finely powdered, and subjected to soxhlet extraction using two different solvent combinations:(f1) ethyl acetate, acetone and ethanol in the ratio of 40:30:30, and (f2) methanol and distilled water in the ratio of 70:30. the obtained extracts were then analyzed for the presence of various phytochemical constituents, and their anti-bacterial potential was subsequently assessed.The study involved screening for phytochemical constituents and evaluation of antibacterial activity of the root extracts against gram-positive bacteria (Staphylococcus aureus, Enterococcus faecalis, Bacillus subtilis) and gram-negative bacteria (Escherichia coli). Standardization parameters including moisture content, acid-insoluble and water-soluble extractive values were assessed to ensure quality and purity.[17] The highest extractive values were found for water-soluble extracts. Methanolic extracts showed the highest number of phytochemicals, indicating significant medical potential for treating various diseases. The study highlights the bioactive substances in Thuja occidentalis roots that contribute to its antibacterial effects and therapeutic utility.

4. Phytochemical screening:-

Phytochemical screening of Thuja occidentalis typically involves testing for compounds like alkaloids, flavonoids, tannins, saponins, and terpenoids. These screenings help identify the presence of bioactive compounds with potential medicinal properties in the plant. [18]

Table 3: The chemical composition of the fresh and dried Thuja occidentalis.

Chemical Composition of the Fresh Plant	
Essential oil (*v*/*w*) Essential oil compounds (mainly monoterpenes): thujone (65%); isothujone (8%); fenchone (8%); Sabines (5%); α-pinene (2%)	0.6%
Reducing sugar	2.07%
Minerals	2.11%
Free acids	1.67%
Tannic agents	1.31%
The Constituents of the Dried Herbal Substance (*Thuja occidentalis Herbal*)	
Essential oil	Borneol Camphene Fenchone Limonene Myrcene α-Terpene Terpinolene Thujone (85% α-thujone and 15% β-thujone) is the main compound (0.76–2.4%)
Coumarins	*p*-Coumaric acid Umbelliferon
Flavonoids	Kaempferol Kaempferol-3-*O*-α-rhamnoside Mearnsitrin Myricetine Myricitrin Quercetin Quercitrin
Tannins	Catechin Gallocatechine
Proanthocyanidines	Procyanidin B-3 Prodelphinidin

5. Thujone:

Thujone is the monoterpene found in the composition of many plants including *Thuja occidentalis*. However, the use of this compound is regulated by the European Parliament and Council and the European Medicines Agency [34]. The isomers α-thujone and β-thujone are monoterpene ketones, with the following IUPAC name: (1*S*,4*R*,5*R*)-4-methyl-1-(propane-2-yl) bicyclo (3.1.0) hexan-3-one. The essential oil of the fresh leaves (related to the monoterpene fraction) contains 65% thujone, 8% isothujone, 8% fenchone, 5% Sabines and 2% α-pine as the main monoterpenes. α-Thujone is recognized as atoxic compound found in absithe, a beverage that was widely consumed during the 19th

and 20th centuries and was associated with harmful health effects. This compound is also major component of wormwood oil and is present in several herbal preparations.in addition, α-Thujone has been reported to exhibit various biological activities, including pain relieving, insecticidal, and anthelmintic effects. Thujone can cause seizures, kidney failure, vomiting, and other serious side effects. When applied to the skin: Wormwood extract is possibly safe as an ointment. Pregnancy: Wormwood is likely unsafe when taken by mouth as medicine during pregnancy. Some wormwood products contain the chemical thujone[19]. Thujone is reported to be toxic to brain, kidney, and liver cells and could cause convulsions if used in too high a dose. Other thujone-containing plants such as the tree arborvitae (Thuja occidentalis) are used in herbal medicine, mainly for their alleged immune-system stimulating effects.

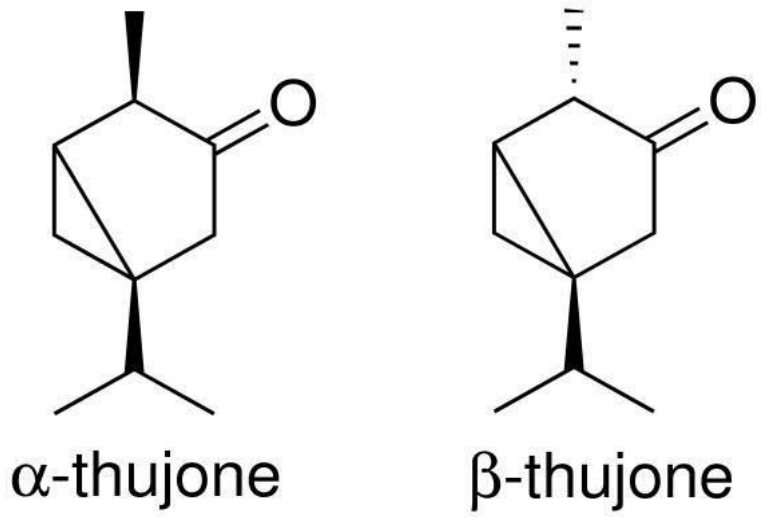

Figure 8. Structure of thujone

6. General uses of the plant:

- It is traditionally used to cure coughs.
- Like many other members of the Cupressaceae family, Thuja can cause allergic reactions that include breathing issues, skin and eye.
- The plant has been extensively studied and shown to possess various beneficial properties, such as anti-epileptic, antiviral, antiallergic, antibacterial, antioxidant, and hair-growth-promoting effects.
- Scalds and burns can be treated with the root and bark.
- The leaves are used to treat a variety of ailments, including those that are antibacterial, astringent, antipyretic, stomachic, antitussive, antipyretic and diuretic.
- The usage of trees in general for various medicinal products and aromatherapy concoctions dates back a long way
- It has been used externally to cure fungal skin illnesses including ringworm and thrush, reduce the discomfort associated with arthritis and rheumatism, and eradicate anal or vaginal warts.
- The tree is known as arbour vitae or the "tree of life" because of its vitamin C-rich leaves and twigs, which are beneficial in preventing or treating scurvy.

7. Biological activities of *Thuja occidentalis* plant:

➢ Anti-Inflammatory Activity

Anti-Inflammatory Activity Inflammation is a necessary defence mechanism which takes place when tissue is damaged, in a manner of providing a means of repairing tissue. Activation of macrophages is triggered by the extravasation of neutrophil in the capillary network and results in the release of various proinflammatory cytokines that encompass TNF-a, interleukins, and interferons that are essential in the regulation of the inflammatory responses. Despite the scarcity, a few studies have been conducted on the investigation of the anti antiinflammatory properties of the components present in T. occidentalis.

➢ Antifungal Activity

Thuja occidentalis leaf and cones their essential oil exhibited antibacterial activity against such yeast as Candida albicans, such fungus as Aspergillus flavus and Aspergillus niger and such Gram-positive bacteria like Staphylococcus aureus and Listeria monocytogenes.[20] The gram-negative microorganisms such as Aeromonas hydrophila, Salmonella typhimurium, Escherichia coli and Pseudomonas. The essential oils may have antifungal properties.

➢ Antiviral Activity

T. occidentalis polysaccharides have demonstrated anti-viral potential against viruses such as HIV1 and influenza A. At higher concentrations (625 ug/ml), thuja polysaccharides (TPS) showed significant inhibitory effects on HIV replication. Additionally, studies indicated that these polysaccharides did not prouduce toxic effects on unifected MP-2 and MT-4 cells, confirming their safety towards normal cells. The findings suggest that high molecular weight polysaccharides derived from Thuja Occidentalis may contribute to anti-viral activity against HIV-1.

➢ Hair growth promoting activity

T. orientalis has a long history of use in the East Asia and was applied in the treatment of individuals with baldness and hair loss. The study of T. orientalis reported by Zhang et al. demonstrated that T. orientalis hot water extract induced the anagen stage of the telogenic mouse N mice of C57BL/6. growth. As compared to either the control group or the group receiving topical treatment with 1% minoxidil, topical treatment with T. orientalis extract induced an earlier anagen phase and increased the mature anagen phase.

➢ Antimicrobial activity:

The T. orientalis Essential oil seed coat against six bacterial pathogens, such as Aspergillus niger, Aspergillus fumigatus, Rhizopus oryzae, Fusarium psidi and Curvularia lunata, and five fungal pathogens. The oil was actually good to moderate acting against all six test cultures. The most dominant monoterpenes ketones in all samples were a- and ss-thujone, fenchone and sabinene and the diterpenes beyerene and rimuene. Malik and Singh 28 evaluated the antimicrobial efficacy of thuja leaf essential oil against bacteria of the urinary tract using E. coli, S. aureus, S. epidermidis, P. aeruginosa, E. cloacae, K. pneumoniae, Candida albicans, C. tropicalis, and C. glabrata. Whereas E. coli was detected to be a resistant bacteria, P. mirabilus and S. aureus were also established as the most susceptible bacteria.

➢ Antibacterial activity:

Antimicrobial agents come in the form of essential oils, which are useful sources. It is also widely known that plants come equipped with antibacterial elements as these elements have been used as the basis of generating new medication compounds applied in herbal remedies used in the treatment of human health. According to Chen and colleagues, Streptococcus mutans was not chelated by T. orientalis even at low doses on the basis of alpha, beta and gamma thujaplicin.[21] The alcohol extract of Thuja occidentalis twigs tested in vitro against Pseudomonas aeruginosa, Yersinia aldovae, Citrobacter, Shigella flexneri, E. coli, and Staphylococcus aureus on the basis of the antibacterial and antifungal attributes of Vernonia anthelmintica, Dryopteris chrysocoma and Trachyspermum ammi. Six microscopic species including Citrobacter, Escherichia coli, Staphylococcus aureus, Yersinia aldovae, Shigella flexenari, and Pseudomonas aeruginosa were tested on antibacterial by demonstrating the presence of strong movement in all bacteria.

8. Conclusion:

Thuja occidentalis commonly known as white cedar or arborvitae is a medicinally important plant possessing immense ethnobotanical, phytochemical, and pharmacological value. It is also used traditionally in different cultures in the areas of skin ailments, respiratory, and metabolic illnesses like diabetes and high lipid. The biotic properties of the plant have been credited with the presence of bioactive constituents such as thujone, flavonoids and polysaccharides, which make it have been attributed with the following properties; antimicrobial, antifungal, anticancer, antioxidant and immunomodulatory. All these effects provided by Thuja occidentalis as an alternative and integrative medicine are multifaceted therapeutic effects. Nevertheless, extensive investigation and clinical testing would be needed so as to convincingly determine its effectiveness and safety to be used by pharmacists across the board, so that best extraction procedures would be put in place to offset the toxic elements such as thujone. Future research will increase its possibilities as a safe, effective herbal medicine in contemporary medicine.

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